Off flavour in recirculated aquaculture systems

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Publication date:
2016

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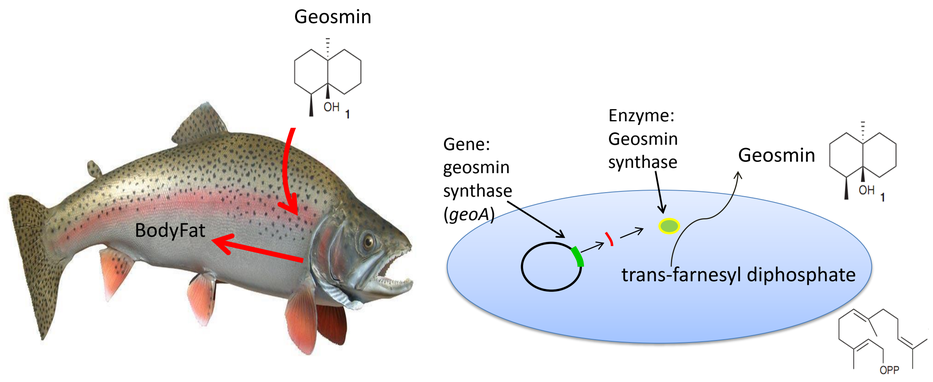
Introduction

Earthy off-flavour (geosmin) in farmed fish is a global problem of major economic impact for fish farmers and wine producers. Especially in recirculated aquaculture systems (RAS) with low exchange of water it can significantly affect the economy of the farm. Geosmin is a secondary metabolite which is produced by a few organisms containing the geosmin synthetase gene (*geoA*).



Homology search of the *geoA* has allowed us to identify at least three abundant groups of bacteria that can produce geosmin:

1) *Actinomycetales* (*Streptomyces and 5 other clades*)
2) Freshwater *Cyanobacteria*
3) *Myxococcales*

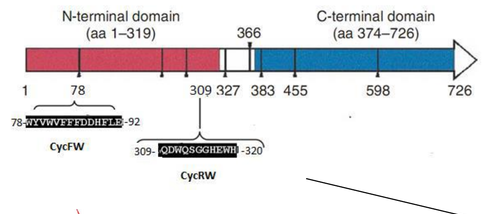
Quantification were performed by qPCR for the most abundant groups using *geoA* and the impact on microbial community composition were carried out by amplicon sequencing of the 16S rRNA gene. Relative abundance of geosmin-producing bacteria were evaluated statistically with environmental and operational parameters in aquaculture systems as well as the effect on the entire microbial community.

Methods

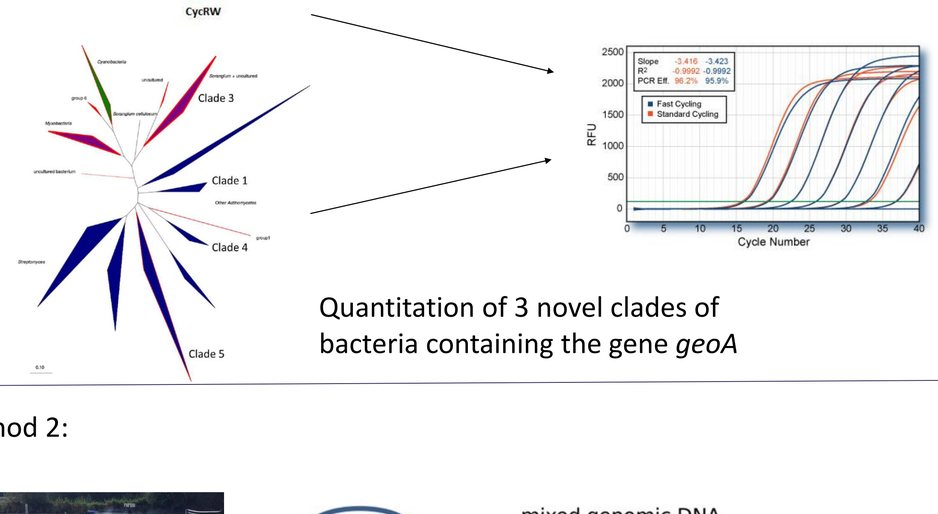
Sample type	DK	CH	F	NL
Inflow water	8	5	3	11
Outflow water	8	5	3	11
Biofilter	8	3	4	11

Total number of samples analysed > 50

Method 1:

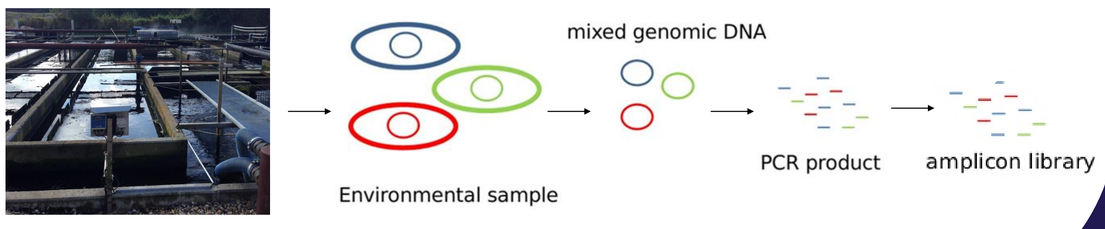


Quantification of *geoA* using degenerated primers



Quantitation of 3 novel clades of bacteria containing the gene *geoA*

Method 2:



Results

Quantification (qPCR) of the bacterial groups in each plant

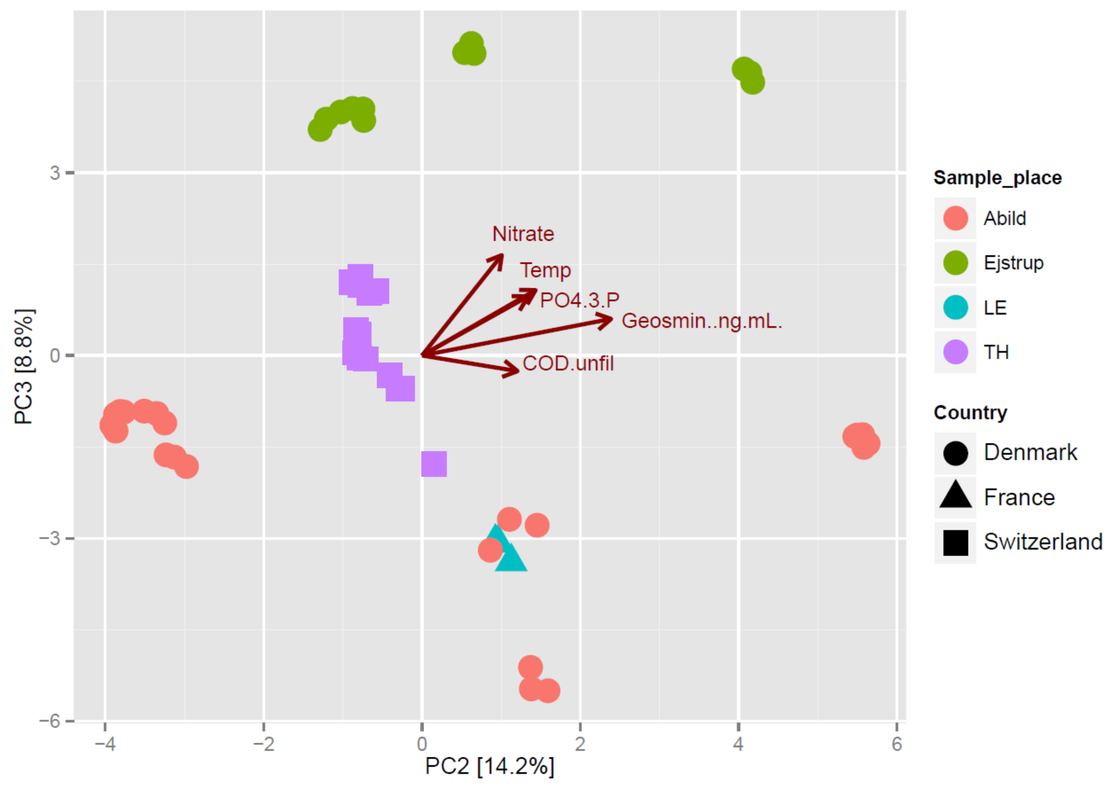
Sample	geoA gene (% of total bacteria)			
	Clade 1	Clade 3	Clade 5	Cyc
Plant 1 (Water, outdoor)	0.0052%	0.00083%	0.034%	0.035%
Plant 1 (Biofilter, outdoor)	0.14%	0.15%	0.0078%	0.0078%
Plant 2 (Water, outdoor)	0.0069%	0.00082%	0.00023%	0.014%
Plant 2 (Biofilter, outdoor)	0.039%	0.022%	0.00012%	0.048%
Plant 3 (Water, indoor)	0.0017%	0.00%	0.0062%	0.16%
Plant 3 (Biofilter, indoor)	0.047%	0.00043%	0.00017%	0.0031%
Plant 4 (Water, indoor)	0.000087%	0.00025%	0.0037%	0.0034%
Plant 4 (Biofilter, indoor)	0.0028%	0.21%	0.016%	0.032%

3 bacterial clades present in most farms

geoA containing bacteria exists in a low amount in RAS, compared to total bacteria

Biofilters showed to contain the highest amount of *geoA*

Correlations between environmental factors in the plants



Geosmin correlates positive to COD, phosphate, and temperature

Conclusions

- Large differences between *geoA*-producing bacteria in plants
- *geoA* containing bacteria was found in low amounts in all plants (most abundant in filters)
- Several environmental factores correlate positive with geosmin. Such correlations can be used as a diagnostic tool in developing strategies to limit the growth of geosmin-producing bacteria.